## 5.3 Assessing Vulnerability

Requirement: §201.4(c)(2)(ii): [The risk assessment shall include the following:] An overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments as well as the State risk assessment. The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards and most vulnerable to damage and loss associated with hazard events. State owned critical or operated facilities located in the identified hazard areas shall also be addressed;

### State Vulnerability

The vulnerability assessment provided in the original Plan is revised and replaced in whole with this update. The completion of all county and nearly all local multi-hazard mitigation plans has resulted in additional data being available for evaluating the State's vulnerability to hazards. The State also desires to simplify some of the detailed analyses to focus on the State-owned facilities and updated population statistics. For example, digital geospatial floodplain data was missing for three counties in the original Plan. That data is now available for all 15 counties in the State and can be used to enhance the estimation of State-owned facilities and population exposed to flooding. Other hazards that reflect significant base data changes include drought, dam failure, hazardous materials incidents, fissures, wildfires, and winter storms.

The vulnerability assessment for this Plan update is comprised of three key components:

1. State Asset Inventory
2. State Loss Estimation
3. Local Vulnerability Summary

The procedures and methodology used by the Planning Team to accomplish each of the three components are discussed and summarized in the following subsections.

### State Asset Inventory

A key component of the vulnerability analysis is the identification and location of assets. For the purpose of this Plan update, an asset is defined as:

> *Any natural or human-caused feature that has value, including, but not limited to people; buildings; infrastructure like bridges, roads, and sewer and water systems; lifelines like electricity and communication resources; or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks.*

The assets specifically considered in this Plan update are generally categorized as either human or structural. Human assets would include the general population and can be sub-grouped by age. Structural assets pertain more to the inanimate physical realm of constructed or planned infrastructure and facilities.

### Structural Assets

In general, structural assets identified within the State are classified as either critical or non-critical facilities and infrastructure. Critical facilities and infrastructure are those systems within the State whose incapacity or destruction would have a debilitating impact on the State's ability to recover following a major disaster, or to defend the people and structures of the State from further hazards. Following the criteria set forth by the Critical Infrastructure Assurance Office (CIAO – Executive Order 13010), the table below summarizes the eight general categories that the State has adopted to define critical facilities and infrastructure.:

| | |
|---|---|
| Communications Infrastructure | • Fiber Optic Lines<br>• Radio, Cellular, and/or Microwave Towers<br>• Large, trunk-line cables<br>• Switch Offices |
| Electrical Power Systems | • High Voltage Transmission Lines<br>• Transform Substations<br>• Generation Stations |
| Gas and Oil Facilities | • Conveyance or Delivery Pipelines<br>• Major Storage Locations (10,000 gallons or larger)<br>• Production Facilities<br>• Refineries<br>• Natural Gas Pipelines (4-inch and larger)<br>• Fuel and Oil Dispensing Locations Owned by the State |
| Banking and Finance Institutions | • Local Banks<br>• Credit Unions |

| | |
|---|---|
| Transportation Networks | • Interstates<br>• US or State Highways<br>• Major Local Arterial Roadways<br>• Railways<br>• Rail Yards<br>• Train Depots<br>• Airports<br>• Major Bridges, Culverts, and Storm Drains |
| Water Supply Systems | • Water Treatment Plants<br>• Sewer Treatment Plants<br>• Water Supply Reservoirs<br>• Water Supply Wells<br>• Primary Delivery Pipelines (10-inch and larger)<br>• Booster or Pump Stations<br>• Storage Tanks<br>• Water Towers |
| Government Services | • City, County, and/or State Administrative Buildings<br>• Facility Yards<br>• Military Bases<br>• Emergency Operation Centers<br>• IT Support Centers<br>• Correctional Facilities |
| Emergency Services | • Fire Stations<br>• Police Stations<br>• Sheriff's Stations<br>• Hospitals<br>• Trauma or Urgent Care Centers<br>• Evacuation Centers<br>• Ambulance Centers |

Typically, other assets such as public libraries, educational institutions (universities, colleges, and other schools), museums, parks, recreational facilities, historic buildings or sites, churches, residential and/or commercial subdivisions, apartment complexes, and so forth, are classified as non-critical facilities and infrastructure, as they are not necessarily "critical" per the definition set forth in Executive Order 13010. Most State-owned facilities of these types, however, are very important to the State in that they often can function as emergency shelters and housing, and/or staging areas for fire-fight and rescue operations. The following is a list of six additional categories used to further define State-owned assets. These facilities may be classified as either critical or non-critical depending on the potential for the asset to serve a secondary emergency use.

| | |
|---|---|
| Educational | • Schools (Elementary, Middle, High School, Charters, Private)<br>• Colleges and Universities<br>• Stadiums |
| Cultural | • Churches<br>• Historic Buildings, Parks or Structures<br>• Museums |
| Businesses | • Government owned buildings that operate as business centers<br>• Buildings leased to commercial vendors |
| Residential | • Structures used primarily for living quarters or residential purposes:<br>o Houses<br>o Apartments<br>o Mobile Homes,<br>o Dining halls<br>o Cafeterias, etc. |

| | |
|---|---|
| Recreation/Leisure | • Swimming Pools<br>• Golf Courses<br>• Parks<br>• Gymnasiums<br>• Recreation Halls<br>• Lounges<br>• State Park Facilities |

During the original planning effort, the Planning Team performed a detailed asset inventory to collect and locate State-owned facilities. Asset data collected included the facility's physical location, name, responsible agency, square footage, replacement cost, and latitude and longitude coordinates. For the Plan update, the original data set was obtained and updated to:

- Reflect current replacement costs
- Include a classification designation of either critical or non-critical
- Include an asset category assignment

The "Summary of State-Owned Asset Inventory Loss Estimates Based on…" table summarizes by category and classification the number of State-owned facilities identified and their respective cumulative replacement costs. It should be noted that replacement costs were not estimated for all structures and will require further investigation and estimates during future planning efforts.

### Data Tables

For the purpose of updating the vulnerability and risk assessment data of this Plan, the following steps were taken to develop the tables found in this section:

"Summary of State-Owned Asset Inventory Loss Estimates Based on…" – Developed by using GIS capabilities by intersecting spatially referenced state facilities with particular hazard areas to determine the total number of facilities that are exposed to the hazard. Using the estimated replacement cost assigned to each facility, losses were then estimated using loss-to-exposure ratios that were obtained from either published sources, were subjectively assigned based on trends noted in the historic record, or by some other rationale. The assignment of loss-to-exposure ratios are summarized in the text of the appropriate hazards.

The capability of quantitatively performing a vulnerability assessment for state facilities using the GIS tools and intersecting method was only possible for dam inundation, flooding, hazardous materials incidents and wildfire due to availability and type of data. For all other hazards, it was assumed that all state-owned facilities are equally exposed unless otherwise noted.

"State Facilities Located in the ---- Hazard Area by Jurisdictions Most Threatened" – as part of the requirement of Assessing Vulnerability of State Facilities, this new table was developed. The data for this table was extracted from data used to develop the Summary table listed above. "Jurisdictions Most Threatened" was determined from a combination of number of facilities and Total Loss Estimates. Jurisdiction location information listed as "Unincorporated" was not used for these tables. Therefore, some locations listed as unincorporated have a higher threat level than those of the specific jurisdictions used for the table. In these cases, the next few with the highest threat with specific jurisdictions were used. Since this is a new table and the only hazards that have a true qualitative vulnerability assessment, Dam Inundation (to represent Dam Failure), Flooding/Flash Flooding, Hazardous Materials Incidents and Wildfire are represented by these tables. These tables can be found in their respective hazard profiles that follow. Efforts to collect data for this and other tables for the remaining hazards will be made over future Plan updates.

"County Population Sectors exposed to…" – Developed using GIS capabilities by intersecting US Census population data from census year 2000 using data (spatially referenced or georeferenced) and software by Environmental Systems Research Institute and four hazard areas as stated in the "Summary of State-Owned Asset Inventory Loss Estimates…" table. The State of Arizona currently has a population of over 6 million people. The census block population data is projected through 2005 with a total of 5.8 million which is reasonable. The table identities total populations exposed to a particular hazard by county and children under 18 years of age along with the elderly over the age of 65. If zero population exposure is represented for a particular county, it is possible that hazard areas were either not identified, defined or not available at this time.

Originally, an attempt to use HAZUS for this table was made. Due to HAZUS estimates of roughly 1.5 million population for the entire State within the census block data, it was decided this tool would not be useful for this table.

"Summary of Local Risk Assessment & Loss Estimates Based on…" – Developed using data extracted from FEMA approved county plans. In several cases, data was not readily available and a "No Data Available" descriptor was used. Typically, missing data was attributed to either 1) the county did not recognize the particular hazard as a priority and did not evaluate losses for that hazard; or 2) the detailed information of the type reported in the table was not available from the county plan. Mohave, Pima and Santa Cruz Counties prepared multi-jurisdictional plans. Maricopa County and incorporated communities also prepared a semi-multi-jurisdictional plan. The remaining counties and included incorporated communities all prepared individual plans, however, a county-wide summary of exposure and losses are included in the vulnerability assessment section of each plan.

New Tables:

"Ranking of Most Vulnerable Communities (by hazard)" – For Dam Inundation, Flooding, Hazardous Materials Incidents and Wildfires. This table was developed to illustrate the most vulnerable on the local jurisdiction level in addition to the county level. This information was developed by ranking the communities on the following criteria:

- Total Estimated Loss
- % of Total Value
- Total Population Exposed
- % of Total Population

These complete tables are in Appendix C.

"State Facilities Located in the ****** Hazard Area by Jurisdiction" – For Dam Inundation, Flooding, Hazardous Materials Incidents and Wildfires. Using the list of state-owned facilities and data used for other tables in the vulnerability assessment, location were determined and recorded and separated by hazard.

| Summary of Critical and Non-Critical facilities | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Facility Type | Apache | Cochise | Coconino | Gila | Graham | Greenlee | La Paz | Maricopa | Mohave | Navajo | Pima | Pinal | Santa Cruz | Yavapai | Yuma | State Total |
| Critical Facilities and Infrastructure | | | | | | | | | | | | | | | | |
| Communications | 9 | 4 | 11 | 3 | 2 | 0 | 2 | 10 | 6 | 6 | 7 | 1 | 1 | 5 | 3 | 70 |
| Electrical Power | 0 | 0 | 4 | 2 | 3 | 1 | 0 | 6 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 19 |
| Gas/Oil Facilities | 9 | 6 | 10 | 12 | 4 | 3 | 6 | 20 | 9 | 12 | 8 | 13 | 2 | 10 | 3 | 127 |
| Banking and/Finance | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 |
| Transportation | 18 | 23 | 35 | 6 | 0 | 3 | 23 | 37 | 23 | 0 | 12 | 8 | 2 | 16 | 14 | 220 |
| Water Supply Systems | 7 | 7 | 25 | 12 | 13 | 5 | 14 | 29 | 10 | 6 | 19 | 28 | 2 | 9 | 5 | 191 |
| Government Services | 71 | 129 | 156 | 97 | 120 | 21 | 45 | 832 | 84 | 123 | 236 | 337 | 13 | 98 | 67 | 2,429 |
| Emergency Services | 0 | 3 | 2 | 0 | 4 | 0 | 0 | 27 | 0 | 1 | 34 | 15 | 0 | 0 | 3 | 89 |
| Recreational/Leisure* | 6 | 8 | 8 | 7 | 15 | 0 | 22 | 58 | 19 | 3 | 32 | 10 | 3 | 26 | 1 | 218 |
| Residential* | 19 | 32 | 68 | 33 | 81 | 2 | 19 | 149 | 14 | 19 | 106 | 117 | 3 | 28 | 24 | 714 |
| Cultural* | 0 | 2 | 6 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 10 | 1 | 0 | 18 | 4 | 45 |
| Educational* | 0 | 11 | 67 | 5 | 13 | 0 | 0 | 184 | 0 | 1 | 460 | 39 | 1 | 0 | 38 | 819 |
| Businesses* | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 7 | 0 | 0 | 14 | 2 | 1 | 1 | 0 | 27 |
| Non-Critical Facilities and Infrastructure | | | | | | | | | | | | | | | | |
| Cultural* | 0 | 4 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 16 | 8 | 14 | 55 |
| Flood Control | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Businesses* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| Recreational/Leisure* | 6 | 4 | 3 | 0 | 9 | 0 | 18 | 0 | 10 | 1 | 4 | 18 | 12 | 7 | 0 | 92 |

### Local Jurisdiction Vulnerability

Multi-hazard mitigation planning using a multi-jurisdictional approach has been conducted by all 15 counties within the State of Arizona. Maricopa, Mohave, Pima, and Santa Cruz Counties prepared official multi-jurisdictional plans that included all incorporated communities within the respective county's boundary. The remaining Counties of Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Navajo, Pinal, Yavapai, and Yuma, and the respective incorporated communities represented by those counties, all prepared individual hazard mitigation plans for their respective jurisdiction.

For this Plan update, the Planning Team reviewed the vulnerability assessment results for each county and local plan, compiled the data by hazard, and then summarized the data by county. Summaries of that effort are provided for each hazard addressed in this section.

It is noted that in the county plan results summaries, there may be hazards for which no data exists. This is either because the county/communities did not perform a vulnerability assessment for the particular hazard, or the assessment simply did not provide any exposure or loss estimates. In either case, a simple "Data Not Available" notation is made.

### Population

Historic and projected populations for the counties and selected local jurisdictions were provided in Section 4. In this section we have provided a summary of that data based on the following criteria:

- Total population
- Number of persons under 18 years old (potentially vulnerable population group)
- Number of persons 65 years and older (potentially vulnerable population group)
- Number of persons living below poverty level (potentially vulnerable population group)

Maricopa County (which includes Phoenix, Mesa, and numerous other local jurisdictions) has by far the largest population in the State, both in terms of total population and households as well as in terms of potentially vulnerable population groups. Pima County (which includes Tucson) is the next largest county.

| Population in Arizona, 2005 | |
|---|---|
| State/County | Population |
| State of Arizona | 6,044,985 |
| Apache | 73,775 |
| Cochise | 131,790 |
| Coconino | 130,530 |
| Gila | 54,445 |
| Graham | 35,455 |
| Greenlee | 8,300 |
| La Paz | 21,190 |
| Maricopa | 3,648,545 |
| Mohave | 188,035 |
| Navajo | 109,985 |
| Pima | 957,635 |
| Pinal | 246,660 |
| Santa Cruz | 44,055 |
| Yavapai | 205,105 |
| Yuma | 189,480 |
| Source: Arizona Department of Commerce, January 2007 | |

Arizona has a relatively small number but high proportion of population that may be vulnerable to hazards, as shown below. These populations have historically involved the following populations: those that are very young or very old and households earning very low incomes. With an overall population of 6,044,985, the State includes a resident base with approximately 31% of its inhabitants under the age of 18, while 13% are 65 and over. Together these aged and young age groups comprise 2,662,211 residents, or 44%, of the State's overall population. Furthermore, Arizona's income levels reflect 9% of the population living at below poverty level.

| Populations Potentially Vulnerable to Hazards, 2005 | | |
|---|---|---|
| Under 18 years | 65 years & older | Below Poverty Level |
| 1,866,691 | 795,520 | 548,383 |
| Note: Poverty level as defined by US Census Bureau.<br>Source: US Census Bureau and AZ Dept of Commerce. | | |

### Growth and Assessing Vulnerability

Arizona has experienced significant growth in the recent years. Statewide, 2000 – 2005 brought a population increase of 17.8% and 1990 – 2005 was 65%. We realize growth may result in challenges in developing housing, retail, infrastructure, etc. These challenges will be mostly evident in areas of growth that are in hazard prone areas. This will in turn, drive the need for more or enhanced planning mechanisms at the local level to ensure smart growth. We realize there will also be an increase in the need for mitigation activities to protect the existing and new development. Therefore, Arizona's growth and development will be closely studied during the next update of this Plan. The studies will most likely result in closer coordination with the growing jurisdictions to ensure their mitigation plans are reflective of their growth and challenges and they have a Mitigation Strategy supportive of it. For this Plan, we examined the top four growing counties and their top growing jurisdictions. Future updates will include the same for more of the counties showing a reasonable amount of growth. This update examined and determined the following:

| Top Growing Counties from 2000 - 2006 | |
|---|---|
| County | Growth % |
| Pinal | 51% |
| Mohave | 24.5% |
| Yavapai | 24.2% |
| Maricopa | 22.6% |

| Top Growing Jurisdictions in Top Growing Counties | | | | | | |
|---|---|---|---|---|---|---|
| | | | Hazard Area Located In | | | |
| Jurisdiction | County | Growth % | Dam Inund | Flooding | HazMat | Wildfire |
| Maricopa | Pinal | 1743% | | | | |
| Queen Creek | Pinal | 433% | | X | X | |
| Gilbert | Maricopa | 64% | X | X | X | |
| Prescott Valley | Yavapai | 52% | | | | |
| Kingman | Mohave | 38% | | | | |
| Peoria | Maricopa | 34% | X | X | X | |
| Chandler | Maricopa | 31% | X | X | X | |
| Lake Havasu City | Mohave | 30% | | | | |
| Prescott | Yavapai | 24% | | | X | X |
| Cottonwood | Yavapai | 19% | | X | X | X |
| Camp Verde | Yavapai | 19% | | X | X | X |
| Bullhead City | Mohave | 18% | | | | |
| Mesa | Maricopa | 14% | X | X | X | |
| Determined | | | | | | |